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TITLE: Hybrid type vehicle drive control apparatus, hybrid type vehicle drive control method, and program thereof

Abstract Paragraph (1):
A hybrid type vehicle drive control apparatus having a generator; a generator inverter for driving the generator; a drive motor; a drive motor inverter for driving the drive motor; a battery connected to the generator inverter and the drive motor inverter; a first voltage detection device that detects a voltage applied to the generator inverter; a second voltage detection device that detects a voltage applied to the drive motor inverter; a third voltage detection device that detects a battery voltage; and a system voltage determination processing means for determining a system voltage based on detection results provided by the first to third voltage detection devices.

Current US Classification, US Primary Class/Subclass (1):
701/22

Summary of Invention Paragraph (5):
[0004] In a conventional hybrid type vehicle drive apparatus installed in a hybrid type vehicle in which a torque of an engine, that is, a portion of the engine torque, is transferred to an electric generator (generator-motor), and the remainder of the engine torque is transferred to driving wheels, a planetary gear unit is provided that includes a sun gear, a ring gear and a carrier. The carrier is connected to the engine, the ring gear is connected to the drive wheels, and the sun gear is connected to the generator. In such drive apparatus, rotation output from the ring gear and a drive motor is transferred to the drive wheels so as to produce a drive force.

Summary of Invention Paragraph (6):
[0005] In the aforementioned hybrid type vehicle drive apparatus, a generator rotation speed control is performed so as to adjust the rotation speed of the engine while a torque control is being performed so that a predetermined engine torque is produced, for example, after the engine has been started. In the generator rotation speed control, the torque of the generator, that is, the generator torque, is controlled based on the rotation speed of the generator, that is, a difference between a target generator rotation speed that represents a target value of the generator rotation speed and an actual generator rotation speed, that is, the difference rotation speed.

Summary of Invention Paragraph (7):
[0006] However, in the hybrid type vehicle drive apparatus, a battery voltage sensor is disposed for detecting the voltage of a battery, that is, the battery voltage, as voltage information, and various drive controls, including a torque control of the generator, a rotation speed control of the generator, a torque control of the drive motor, etc., are performed based on the battery voltage. For example, if the battery voltage becomes high in a case where a hybrid type vehicle is run on a long continuous downhill or the like, the load on an inverter for driving the generator becomes great. Therefore, if the battery voltage is high, the generator torque is restricted.

Summary of Invention Paragraph (8):

[0007] However, if a detection abnormality occurs in the battery voltage sensor in the aforementioned conventional hybrid type vehicle drive apparatus, it becomes very difficult or even impossible to accurately detect the battery voltage, so that the drive control cannot be smoothly performed.

Summary of Invention Paragraph (10):
[0008] A hybrid type vehicle drive control apparatus in accordance with the invention includes an electric generator that generates an electric power by driving an engine; an electric generator inverter for driving the electric generator; a drive motor that drives a hybrid type vehicle; a drive motor inverter for driving the drive motor; a battery connected to the electric generator inverter and the drive motor inverter; first voltage detection means for detecting a voltage applied to the electric generator inverter; second voltage detection means for detecting a voltage applied to the drive motor inverter; third voltage detection means for detecting a battery voltage; and system voltage determination processing means for determining a system voltage based on detection results provided by the first to third voltage detection means.

Summary of Invention Paragraph (15):
[0013] A hybrid type vehicle drive control method in accordance with the invention is applicable to a hybrid type vehicle drive apparatus that includes an electric generator that generates an electric power by driving an engine; an electric generator inverter for driving the electric generator; a drive motor that drives a hybrid type vehicle; and a drive motor inverter for driving the drive motor; and a battery connected to the electric generator inverter and the drive motor inverter.

Summary of Invention Paragraph (16):
[0014] In this method, a voltage applied to the electric generator inverter is detected by first voltage detection means, a voltage applied to the drive motor inverter is detected by second voltage detection means, and a battery voltage is detected by third voltage detection means. A system voltage is determined based on detection results provided by the first to third voltage detection means.

Summary of Invention Paragraph (17):
[0015] A program of a hybrid type vehicle drive control method in accordance with the invention causes a computer to function as first voltage detection means for detecting a voltage applied to an electric generator inverter; second voltage detection means for detecting a voltage applied to a drive motor inverter; third voltage detection means for detecting a battery voltage; and system voltage determination processing means for determining a system voltage based on detection results provided by the first to third voltage detection means.

Brief Description of Drawings Paragraph (7):
[0021] FIG. 5 is a torque diagram for a normal run in the first embodiment of the invention;

Brief Description of Drawings Paragraph (12):
[0026] FIG. 10 is a diagram indicating a first vehicle-requested torque map in the first embodiment of the invention;

Brief Description of Drawings Paragraph (13):
[0027] FIG. 11 is a diagram indicating a second vehicle-requested torque map in the first embodiment of the invention;

Brief Description of Drawings Paragraph (19):
[0033] FIG. 17 is a chart illustrating a sub-routine of a generator torque control process in the first embodiment of the invention;

Brief Description of Drawings Paragraph (22):
[0036] FIG. 20 is a diagram indicating a generator torque restriction map in the first embodiment of the invention;

Detail Description Paragraph (4):
[0043] Shown in FIG. 1 are a generator 16 for generating electric power by driving an engine (not shown); an inverter 28 as a generator inverter for driving the

generator 16; a drive motor 25 that drives a hybrid type vehicle; an inverter 29 as a drive motor inverter for driving the drive motor 25; a battery 43 connected to the inverters 28, 29; a first voltage detection means 75, such as, for example, generator inverter sensor 75, to detect the voltage applied to the generator inverter; a second voltage detection means 76, such as, for example, drive motor inverter sensor 76, to detect the voltage applied to the drive motor inverter; a third voltage detection means 72, such as for example, battery voltage sensor 72, to detect the battery voltage; and a system voltage determination processing means 91 for determining a system voltage based on results of detection by the generator inverter sensor 75, the drive motor inverter sensor 76 and the battery voltage sensor 72.

Detail Description Paragraph (8):
[0047] Furthermore, the generator 16 is made up of a rotor 21 that is fixed to the transfer shaft 17 and is rotatably disposed, a stator 22 disposed around the rotor 21, and coils 23 wound on the stator 22. The generator 16 generates electric power from rotation transferred thereto via the transfer shaft 17. The coils 23 are connected to a battery (not shown in FIG. 2), and supply DC current to the battery. A generator brake B is disposed between the rotor 21 and the case 10. By engaging the generator brake B, the rotor 21 can be fixed to mechanically stop rotation of the generator 16.

Detail Description Paragraph (10):
[0049] The drive motor 25 generates drive motor torque TM from electric current supplied to the coils 42. Therefore, the coils 42 are connected to the battery (not shown in FIG. 2). DC current from the battery is converted into AC current, which is supplied to the coils 42.

Detail Description Paragraph (15):
[0054] By computing a rate of change .DELTA..theta.G of the generator rotor position .theta.G, it is possible to compute the generator rotation speed NG. By computing a rate of change .DELTA..theta.M of the drive motor rotor position .DELTA.M, it is possible to compute the rotation speed of the drive motor 25, that is, the drive motor rotation speed NM. Furthermore, the vehicle speed V can be computed based on the rate of change .DELTA..theta.M, and the gear ratio .gamma.V of a torque transfer system from the output shaft 26 to the drive wheels 37. The generator rotor position .theta.G corresponds to the generator rotation speed NG, and the drive motor rotor position .theta.M corresponds to the drive motor rotation speed NM. Therefore, it is possible to cause the generator rotor position sensor 38 to function as a generator rotation speed detection means for detecting the generator rotation speed NG, and cause the drive motor rotor position sensor 39 to function as a drive motor rotation speed detection means for detecting the drive motor rotation speed NM and as a vehicle speed detection means for detecting the vehicle speed V.

Detail Description Paragraph (16):
[0055] Next described will be operation of the planetary gear unit 13. FIG. 3 is a diagram illustrating the operation of the planetary gear unit in accordance with the first embodiment of the invention. FIG. 4 is a vehicle speed diagram for a normal run of the vehicle in accordance with the first embodiment of the invention. FIG. 5 is a torque diagram for a normal run in accordance with the first embodiment of the invention.

Detail Description Paragraph (22):
[0059] The engine torque TE, the torque produced on the ring gear R, that is, the ring gear torque TR, and the generator torque TG have the following relationship:

Detail Description Paragraph (25):
[0061] During an ordinary run of the hybrid type vehicle, the ring gear R, the carrier CR and the sun gear S are rotated in a positive direction, and the ring gear rotation speed NR, the engine rotation speed NE and the generator rotation speed NG assume positive values as indicated in FIG. 4. The ring gear torque TR and the generator torque TG are acquired by splitting the engine torque TE at a torque ratio that is determined by the number of teeth of the planetary gear unit 13. Therefore, in the torque diagram of FIG. 5, the engine torque TE is the sum of the ring gear torque TR and the generator torque TG.

Detail Description Paragraph (27):
[0063] FIG. 6 shows a case 10; an engine 11 (E/G); a planetary gear unit 13; a generator (G) 16; a generator brake B for fixing a rotor 21 of the generator 16; a drive motor (M) 25; an inverter 28 as a generator inverter for driving the generator 16; an inverter 29 as a drive motor inverter for driving the drive motor 25; drive wheels 37 (one shown); a generator rotor position sensor 38; a drive motor rotor position sensor 39; and a battery 43. The inverters 28, 29 are connected to the battery 43 via a power supply switch SW. When the power supply switch SW is on, the battery 43 sends DC current to the inverters 28, 29. Disposed at an input side of the inverter 28 is a generator inverter sensor 75 as a first voltage detection means for detecting the DC voltage applied to the inverter 28, that is, the generator inverter voltage VG. Disposed at an input side of the inverter 29 is a drive motor inverter sensor 76 as a second voltage detection means for detecting the DC voltage applied to the inverter 29, that is, the drive motor inverter voltage VM. The generator inverter voltage VG and the drive motor inverter voltage VM are sent to a generator control device 47 and a drive motor control device 49, respectively. A smoothing capacitor C is connected between the battery 43 and the inverter 29.

Detail Description Paragraph (29):
[0065] The generator inverter 28 is driven in accordance with the drive signal SG1. At the time of powering (driving), the inverter 28 receives DC current from the battery 43, and generates phase currents, that is, currents IGU, IGV, IGW of a U-phase, a V-phase and a W-phase, and sends the currents IGU, IGV, IGW of the phases to the generator 16. At the time of regeneration (electric power generation), the inverter 28 receives the currents IGU, IGV, IGW, and generates DC currents, and sends the currents to the battery 43.

Detail Description Paragraph (30):
[0066] The drive motor inverter 29 is driven in accordance with the drive signal SG2. At the time of powering, the inverter 29 receives DC current from the battery 43, and generates currents IMU, IMV, IMW of a U-phase, a V-phase and a W-phase, and sends the currents IMU, IMV, IMW of the phases to the drive motor 25. At the time of regeneration, the inverter 29 receives the currents IMU, IMV, IMW, and generates DC currents, and sends the currents to the battery 43.

Detail Description Paragraph (31):
[0067] Further shown are a battery remaining amount detecting device 44 that detects a battery remaining amount SOC as the state of the battery 43, that is, the battery state; an engine rotation speed sensor 52 that detects the engine rotation speed NE; a shift position sensor 53 as a speed selection operating means for detecting the position of a shift lever (not shown), that is, the shift position SP; an accelerator pedal 54; an accelerator switch 55 as an accelerator operation detection means for detecting the position (amount of depression) of the accelerator pedal 54, that is, the accelerator pedal position AP; a brake pedal 61; a brake switch 62 as a brake operation detection means for detecting the position (amount of depression) of the brake pedal 61, that is, the brake pedal position BP; an engine temperature sensor 63 that detects the temperature tmE of the engine 11; a generator temperature sensor 64 that detects the temperature of the generator 16, for example, the temperature tmG of the coils 23 (FIG. 2); and a drive motor temperature sensor 65 that detects the temperature of the drive motor 25, for example, the temperature of the coils 42.

Detail Description Paragraph (32):
[0068] Still further shown are current sensors 66 to 69 that detects the currents IGU, IGV, IMU, IMV, respectively, and a battery voltage sensor 72 as a third voltage detection means for detecting the battery voltage VB as the battery state. The battery voltage VB is sent to the generator control device 47, the drive motor control device 49 and the vehicle control device 51. As a battery state, it is possible to detect battery current, battery temperature, etc. Battery state detection means is formed by the battery remaining amount detecting device 44, the battery voltage sensor 72, a battery current sensor (not shown), a battery temperature sensor (not shown), etc. The battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM form the first to third voltage information pieces.

Detail Description Paragraph (33):
[0069] The vehicle control device 51 sets the driving and stopping of the engine 11 by sending an engine control signal to the engine control device 46, computes the generator rotation speed NG by reading the generator rotor position .theta.G, computes the drive motor rotation speed NM by reading the drive motor rotor position .theta.M, computes the engine rotation speed NE using the rotation speed relational expression, sets in the engine control device 46 a target engine rotation speed NE* that represents a target value of the engine rotation speed NE, sets in the generator control device 47 a target generator rotation speed NG* that represents a target value of the generator rotation speed NG, and a target generator torque TG* that represents a target value of the generator torque TG, and sets in the drive motor control device 49 a target drive motor torque TM* that represents a target value of the drive motor torque TM, and a drive motor torque corrected value .delta.TM that represents a corrected value of the drive motor torque TM.

Detail Description Paragraph (36):
[0072] Next described will be operation of the hybrid type vehicle drive control apparatus constructed as described above. FIG. 7 is a first main flowchart illustrating an operation of the hybrid type vehicle drive control apparatus in the first embodiment of the invention. FIG. 8 is a second main flowchart illustrating an operation of the hybrid type vehicle drive control apparatus in the first embodiment of the invention. FIG. 9 is a third main flowchart illustrating an operation of the hybrid type vehicle drive control apparatus in the first embodiment of the invention. FIG. 10 is a diagram indicating a first vehicle-requested torque map in the first embodiment of the invention. FIG. 11 is a diagram indicating a second vehicle-requested torque map in the first embodiment of the invention. FIG. 12 is a diagram illustrating a target engine operation state map in the first embodiment of the invention. FIG. 13 is a diagram indicating an engine drive region map in the first embodiment of the invention. In FIGS. 10, 11 and 13, the horizontal axis indicates the vehicle speed V, and the vertical axis indicates the vehicle-requested torque TO*. In FIG. 12, the horizontal axis indicates the engine rotation speed NE, and the vertical axis indicates the engine torque TE.

Detail Description Paragraph (37):
[0073] First, the system voltage determination processing means 91 (FIG. 1) of the vehicle control device 51 (FIG. 6) performs a system voltage determining process to determine a system voltage Vsys based on the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM. Next, the vehicle-requested torque determination processing means (not separately shown) of the vehicle control device 51 performs a vehicle-requested torque determining process. That is, the vehicle-requested torque determination processing means reads the accelerator pedal position AP from the accelerator switch 55, and the brake pedal position BP from the brake switch 62, and reads the drive motor rotor position .theta.M from the drive motor rotor position sensor 39, and computes the vehicle speed V. The means determines a vehicle-requested torque TO* needed to run the hybrid type vehicle which is pre-set corresponding to the accelerator pedal position AP, the brake pedal position BP and the vehicle speed V, by referring to the first vehicle-requested torque map of FIG. 10 recorded in a recording device of the vehicle control device 51 if the accelerator pedal 54 is depressed, and by referring to the second vehicle-requested torque map of FIG. 11 recorded in the recording device if the brake pedal 61 is depressed.

Detail Description Paragraph (38):
[0074] Subsequently, the vehicle control device 51 determines whether the vehicle-requested torque TO* is greater than a maximum drive motor torque TMmax that is pre-set as a rated torque of the drive motor 25. If the vehicle-requested torque TO* is greater than the maximum drive motor torque TMmax, the vehicle control device 51 determines whether the engine 11 is at a stop. If the engine 11 is at a stop, a rapid acceleration control processing means (not separately shown) of the vehicle control device 51 performs a rapid acceleration control process, in which the means drives the drive motor 25 and the generator 16 to run the hybrid type vehicle.

Detail Description Paragraph (39):
[0075] If the vehicle-requested torque TO* is not greater than the maximum drive

motor torque TMmax, or if the vehicle-requested torque TO* is greater than the maximum drive motor torque TMmax and the engine 11 is in operation, a driver-requested output computation processing means (not separately shown) of the vehicle control device 51 performs a driver-requested output computing process, in which the vehicle-requested torque TO* is multiplied by the vehicle speed V to determine a driver-requested output PD:

Detail Description Paragraph (41):
[0076] Next, a battery charge-discharge requested output computation processing means (not separately shown) of the vehicle control device 51 performs a battery charge-discharge requested output computing process, in which the battery remaining amount SOC is read from the battery remaining amount detecting device 44, and a battery charge-discharge requested output PB is computed from the battery remaining amount SOC.

Detail Description Paragraph (42):
[0077] Subsequently, a vehicle-requested output computation processing means (not separately shown) of the vehicle control device 51 performs a vehicle-requested output computing process, in which the predetermined drive-requested output PD is added to the battery charge-discharge requested output PB to determine a vehicle-requested output PO:

Detail Description Paragraph (44):
[0078] Subsequently, a target engine operation state setting processing means (not separately shown) of the vehicle control device 51 performs a target engine operation state setting process. That is, referring to the target engine operation state map of FIG. 12 recorded in the recording device, the target engine operation state setting processing means determines points A1 to A3, Am of intersection of lines PO1 to PO3 indicating the vehicle-requested output PO with an optimal fuel economy curve L where the efficiency of the engine 11 becomes highest at each of the accelerator pedal positions AP1 to AP6, as operation points of the engine 11 indicating the target engine operation state. The engine torque TE1 to TE3, TEm at the operation point is determined as a target engine torque TE*. The engine rotation speed NE1 to NE3 at the operation point is determined as a target engine rotation speed NE*.

Detail Description Paragraph (45):
[0079] Then, the vehicle control device 51 determines whether the engine 11 is in a drive region AR1, by referring to the engine drive region map of FIG. 13 recorded in the recording device. In FIG. 13, AR1 represents a drive region in which the engine 11 is driven, and AR2 represents a stop region in which the driving of the engine 11 is stopped, and AR3 represents a hysteresis region. Furthermore, LE1 represents a line on which the engine 11 in a stopped state is driven, and LE2 represents a line on which the engine 11 in a driven state is stopped being driven. As the battery remaining amount SOC increases, the line LE1 is shifted rightward in FIG. 13 so as to reduce the driven region AR1. As the battery remaining amount SOC decreases, the line LE1 is shifted leftward in FIG. 13 so as to increase the drive region AR1.

Detail Description Paragraph (46):
[0080] If the engine 11 is not driven although the engine 11 is in the drive region AR1, a engine startup control processing means (not separately shown) of the vehicle control device 51 performs an engine startup control process to start up the engine 11. If the engine 11 is driven although the engine 11 is not in the drive region AR1, an engine stop control processing means (not separately shown) of the vehicle control device 51 performs an engine stop control process to stop the driving of the engine 11. If the engine 11 is not in the drive region AR1 and the engine 11 is at a stop, a target drive motor torque determination processing means (not separately shown) of the vehicle control device 51 performs a target drive motor torque determination process, in which the vehicle-requested torque TO* is determined as a target drive motor torque TM*, and a not-shown drive motor control processing means of the vehicle control device 51 performs a drive motor control process to perform a torque control of the drive motor 25. As a result, the hybrid type vehicle is run in a motor drive mode.

Detail Description Paragraph (50):

[0084] Therefore, the vehicle control device 51 determines whether the target generator rotation speed NG* is equal to or greater than a predetermined first rotation speed Nth1 (e.g., 500[rpm]). If the absolute value of the target generator rotation speed NG* is equal to or greater than the first rotation speed Nth1, the vehicle control device 51 determines whether the generator brake B has been released. If the generator brake B has been released, a generator rotation speed control processing means (not separately shown) of the vehicle control device 51 performs a generator rotation speed control process to perform a torque control of the generator 16. If the generator brake B is not released, a generator brake release control processing means (not separately shown) of the vehicle control device 51 performs a generator brake release control process so as to release the generator brake B.

Detail Description Paragraph (51):
[0085] If in the generator rotation speed control process, a target generator torque TG* is determined and, on the basis of the target generator torque TG*, a torque control of the generator 16 is performed to generate a predetermined generator torque TG, the generator torque TG is converted into the ring gear torque TR, and is output from the ring gear R because the engine torque TE, the ring gear torque TR, and the generator torque TG are affected by reaction forces from one another as mentioned above.

Detail Description Paragraph (52):
[0086] As the ring gear torque TR is output from the ring gear R, the generator rotation speed NG fluctuates, and the ring gear torque TR fluctuates. The fluctuating ring gear torque TR is transferred to the drive wheels 37, so that the running feeling of the hybrid type vehicle deteriorates. Therefore, the ring gear torque TR is computed, taking into account a torque corresponding to the inertia of the generator 16 (inertia of the rotor 21 and a not-shown rotor shaft) involved in the fluctuations of the generator rotation speed NG.

Detail Description Paragraph (53):
[0087] Therefore, a ring gear torque computation processing means (not separately shown) of the vehicle control device 51 performs a ring gear torque computation process, in which the target generator torque TG* determined in the generator rotation speed control process is read, and a ring gear torque TR is computed based on the target generator torque TG*, and the ratio of the number of teeth of the ring gear R to the number of teeth of the sun gear S.

Detail Description Paragraph (54):
[0088] That is, where the inertia of the generator 16 is expressed as InG and the angular acceleration (rotation change rate) of the generator 16 is expressed as .alpha.G, the sun gear torque TS applied to the sun gear S can be determined by adding a torque equivalent component (inertia torque) TGI corresponding to the inertia InG:

Detail Description Paragraph (56):
[0089] to the target generator torque TG* as in: 1 TS = TG * + TGI = TG * + InG G (3)

Detail Description Paragraph (57):
[0090] Normally, the value assumed by the torque equivalent component TGI during acceleration of the hybrid type vehicle is negative with respect to the accelerating direction. The value of the torque equivalent component TGI during deceleration is positive. Furthermore, the angular acceleration .alpha.G is computed by differentiating the generator rotation speed NG.

Detail Description Paragraph (58):
[0091] If the number of teeth of the ring gear R is .rho. times the number of teeth of the sun gear S, the ring gear torque TR is .rho. times the sun gear torque TS, and therefore TR is expressed as: 2 TR = TS = (TG * + TGI) = (TG * + InG G) (4)

Detail Description Paragraph (59):
[0092] In this manner, the ring gear torque TR can be computed from the target

generator torque TG* and the torque equivalent component TGI.

Detail Description Paragraph (60):
[0093] Therefore, a drive shaft torque estimation processing means (not separately shown) of the vehicle control device 51 performs a drive shaft torque estimation process, in which the torque of the output shaft 26 of the drive motor 25, that is, the drive shaft torque TR/OUT, is computed and estimated based on the target generator torque TG*, and the torque equivalent component TGI corresponding to the inertia InG of the generator 16. Therefore, the drive shaft torque estimation processing means computes the drive shaft torque TR/OUT based on the ring gear torque TR, and the ratio of the number of teeth of the second counter drive gear 27 to the number of teeth of the ring gear R.

Detail Description Paragraph (61):
[0094] If the generator brake B is engaged, the target generator torque TG* is set at zero (0), and therefore the ring gear torque TR has a proportional relationship with the engine torque TE. Therefore, the drive shaft torque estimation processing means reads the engine torque TE from the engine control device 46, and computes a ring gear torque TR from the engine torque TE using the aforementioned torque relational expression, and then estimates the drive shaft torque TR/OUT based on the ring gear torque TR, and the ratio of the number of teeth of the second counter drive gear 27 to the number of teeth of the ring gear R.

Detail Description Paragraph (62):
[0095] Subsequently, the target drive motor torque determination processing means performs a target drive motor torque determination process, in which a surplus or shortfall of the drive shaft TR/OUT is determined as a target drive motor torque TM* by subtracting the drive shaft TR/OUT from the vehicle requested torque TO*.

Detail Description Paragraph (63):
[0096] Then, a drive motor control processing means (not separately shown) of the vehicle control device 51 performs a drive motor control process, in which a torque control of the drive motor 25 is performed based on an estimated drive shaft TR/OUT, so as to control the drive motor torque TM.

Detail Description Paragraph (69):
[0102] Step S4: A vehicle requested torque TO* is determined.

Detail Description Paragraph (70):
[0103] Step S5: It is determined whether the vehicle requested torque TO* is greater than the maximum drive motor torque TMmax. If the vehicle requested torque TO* is greater than the maximum drive motor torque TMmax, the process proceeds to step S6. If the vehicle requested torque TO* is not greater than the maximum drive motor torque TMmax, the process proceeds to step S8.

Detail Description Paragraph (74):
[0107] Step S9: A battery charge-discharge requested output PB is computed.

Detail Description Paragraph (91):
[0124] Step S26: A target drive motor torque TM* is determined.

Detail Description Paragraph (94):
[0127] First, the system voltage determination processing means 91 reads the battery voltage VB, reads the generator inverter voltage VG via the generator control device 47, and reads the drive motor inverter voltage VM via the drive motor control device 49. Next, a detection abnormality determination processing means (not separately shown) of the system voltage determination processing means 91 performs a detection abnormality determination process, in which an abnormality determination regarding the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM is performed based on a difference in voltage, that is, a differential voltage, between two of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM, which are results of detection by the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76, respectively. That is, in the detection abnormality determination process, it is determined whether the absolute value of the value

obtained by subtracting the generator inverter voltage VG from the drive motor inverter voltage VM, that is, a first differential voltage .DELTA.Vmg:

Detail Description Paragraph (97):
[0129] If the first differential voltage .DELTA.Vmg is greater than the threshold value Vth1, the detection abnormality determination processing means determines whether the absolute value of the value obtained by subtracting the battery voltage VB from the generator inverter voltage VG, that is, a second differential voltage .DELTA.Vgb:

Detail Description Paragraph (100):
[0131] If the first differential voltage .DELTA.Vmg is less than or equal to the threshold value Vth1, the detection abnormality determination processing means determines whether the second differential voltage .DELTA.Vgb is greater than the threshold value Vth2. If the second differential voltage .DELTA.Vgb is greater than the threshold value Vth2, the detection abnormality determination processing means determines that the battery voltage VB is abnormal. If the second differential voltage .DELTA.Vgb is less than or equal to the threshold value Vth2, the detection abnormality determination processing means determines that each of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM is normal. Although in this embodiment, the threshold values Vth1 and Vth2 are equal, the threshold values may be different from each other.

Detail Description Paragraph (101):
[0132] If it is determined that the generator inverter voltage VG is abnormal, the system voltage determination processing means 91 sets the battery voltage VB or the drive motor inverter voltage VM as a system voltage Vsys. If it is determined that the drive motor inverter voltage VM is abnormal, the system voltage determination processing means 91 sets the battery voltage VB or the generator inverter voltage VG as a system voltage Vsys. If it is determined that the battery voltage VB is abnormal, the system voltage determination processing means 91 sets the generator inverter voltage VG or the drive motor inverter voltage VM as a system voltage Vsys. If each of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM is normal, the system voltage determination processing means 91 sets the battery voltage VB, the generator inverter voltage VG or the drive motor inverter voltage VM as a system voltage Vsys.

Detail Description Paragraph (102):
[0133] Thus, it is possible to determine whether one of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM is abnormal based on a differential voltage between two of the three voltages. That is, if a detection abnormality occurs in any one of the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76, a system voltage Vsys can be determined based on normal voltages of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM. Therefore, it is possible to smoothly perform various drive controls, such as the torque control of the generator 16, the rotation speed control of the generator 16, the torque control of the drive motor 25, etc.

Detail Description Paragraph (104):
[0135] Step S1-1: The battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM are read.

Detail Description Paragraph (109):
[0140] Step S1-6: The battery voltage VB or the drive motor inverter voltage VM is set as a system voltage Vsys. After that, the process ends.

Detail Description Paragraph (111):
[0142] Step S1-8: The battery voltage VB or the generator inverter voltage VG is set as a system voltage Vsys. After that, the process ends.

Detail Description Paragraph (112):
[0143] Step S1-9: It is determined that the battery voltage VB is abnormal.

Detail Description Paragraph (114):

[0145] Step S1-11: The battery voltage VB, the generator inverter voltage VG or the drive motor inverter voltage VM is set as a system voltage Vsys. After that, the process ends.

Detail Description Paragraph (116):
[0147] First, the rapid acceleration control processing means reads the vehicle-requested torque TO*, and sets the maximum drive motor torque TMmax as a target drive motor torque TM*. Subsequently, a target generator torque computation processing means of the rapid acceleration control processing means performs a target generator torque computation process, in which a differential torque .DELTA.T between the vehicle-requested torque TO* and the target drive motor torque TM* is computed, and a shortfall of the maximum drive motor torque TMmax, which is the target drive motor torque TM*, is computed and determined as a target generator torque TG*.

Detail Description Paragraph (117):
[0148] Then, the drive motor control processing means of the rapid acceleration control processing means performs a drive motor control process, in which the torque control of the drive motor 25 (FIG. 6) is performed based on the target drive motor torque TM*. The generator torque control means of the rapid acceleration control processing means performs the generator torque control process, in which a torque control of the generator 16 is performed based on the generator torque TG.

Detail Description Paragraph (119):
[0150] Step S7-1: The vehicle-requested torque TO* is read

Detail Description Paragraph (120):
[0151] Step S7-2: The maximum drive motor torque TMmax is set as a target drive motor torque TM*.

Detail Description Paragraph (121):
[0152] Step S7-3: The target generator torque TG* is computed.

Detail Description Paragraph (123):
[0154] Step S7-5: The generator torque control process is performed. The process then returns.

Detail Description Paragraph (125):
[0156] First, the drive motor control processing means reads the target drive motor torque TM*, and reads the drive motor rotor position .theta.M. From the drive motor rotor position .theta.M, the drive motor control processing means computes a drive motor rotation speed NM. Subsequently, the means reads the system voltage Vsys. Next, the drive motor control processing means determines a d-axis current instruction value IMd* and a q-axis current instruction value IMq* based on the target drive motor torque TM*, the drive motor rotation speed NM and the system voltage Vsys, with reference to a current instruction value map (not separately shown) for the drive motor control recorded in the recording device.

Detail Description Paragraph (131):
[0161] Step S7-4-1: The target drive motor torque TM* is read.

Detail Description Paragraph (141):
[0171] Next described will be a sub-routine of the generator torque control process of step S7-5 in FIG. 15. FIG. 17 is a chart illustrating the sub-routine of the generator torque control process in the first embodiment of the invention.

Detail Description Paragraph (142):
[0172] First, the generator torque control processing means reads the target generator torque TG*, and reads the generator rotor position .theta.G. From the generator rotor position .theta.G, the means computes a generator rotation speed NG. Subsequently, the means reads the system voltage Vsys. Next, the generator torque control processing means determines a d-axis current instruction value IGd* and a q-axis current instruction value IGq* based on the target generator torque TG*, the generator rotation speed NG and the system voltage Vsys, with reference to a not-shown current instruction value map for generator control recorded in the

recording device.

Detail Description Paragraph (143):
[0173] Furthermore, the generator torque control processing means reads the currents IGU, IGV from the electric current sensors 66, 67 (FIG. 6). From the currents IGU, IGV, the means computes a current IGW:

Detail Description Paragraph (146):
[0175] Subsequently, the generator torque control processing means performs 3-phase/2-phase conversion of converting the currents IGU, IGV, IGW into a d-axis current IGd and a q-axis current IGq. From the d-axis current IGd, the q-axis current IGq, the d-axis current instruction value IGd* and the q-axis current instruction value IGq*, the means computes voltage instruction values VGd*, VGq*. Then, the drive motor control processing means performs 2-phase/3-phase conversion of converting the voltage instruction values VGd*, VGq* into voltage instruction values VGU*, VGV*, VGW*. From the voltage instruction values VGU*, VGV*, VGW*, the means computes pulse width modulation signals SU, SV, SW. Then, the means outputs the pulse width modulation signals SU, SV, SW to a drive processing means of the generator torque control processing means. The drive processing means performs a drive process, and sends a drive signal SG1 to the inverter 28 based on the pulse width modulation signals SU, SV, SW.

Detail Description Paragraph (148):
[0177] Step S7-5-1: The target generator torque TG* is read.

Detail Description Paragraph (163):
[0192] Then, the engine startup control processing means estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process, as in steps S25 to S27.

Detail Description Paragraph (164):
[0193] Furthermore, the engine startup control processing means adjusts the degree of throttle opening .theta. so that the engine rotation speed NE reaches the target engine rotation speed NE*. Next, in order to determine whether the engine 11 is normally driven, the engine startup control processing means determines whether the generator torque TG is smaller than a motoring torque TEth involved in the startup of the engine 11. Then, the means waits for a predetermined time to elapse with the generator torque TG remaining smaller than the motoring torque TEth. If the engine rotation speed NE is less than or equal to the startup rotation speed NEth1, the generator rotation speed control processing means performs the generator rotation speed control process based on the target generator rotation speed NG*. Subsequently, the engine startup control processing means estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process as in steps S25 to S27.

Detail Description Paragraph (173):
[0202] Step S15-8: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (174):
[0203] Step S15-9: The target drive motor torque TM* is determined.

Detail Description Paragraph (178):
[0207] Step S15-13: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (179):
[0208] Step S15-14: The target drive motor torque TM* is determined.

Detail Description Paragraph (182):
[0211] Step S15-17: It is determined whether the generator torque TG is less than the motoring torque TEth. If the generator torque TG is less than the motoring torque TEth, the process proceeds to step S15-18. If the generator torque TG is not less than the motoring torque TEth, the process returns to Step S15-11.

Detail Description Paragraph (184):
[0213] Next described will be a sub-routine of the generator rotation speed control

process of step S23 in FIG. 9, and steps S15-7 and S15-12 in FIG. 18. FIG. 19 is a chart illustrating the sub-routine of the generator rotation speed control process in the first embodiment of the invention. FIG. 20 is a diagram indicating a generator torque restriction map in the first embodiment of the invention. In FIG. 20, the horizontal axis indicates the system voltage Vsys, and the vertical axis indicates the maximum generator torque TGmax.

Detail Description Paragraph (185):
[0214] First, the generator rotation speed control processing means reads the target generator rotation speed NG* and the generator rotation speed NG. The means performs a PI control based on a differential rotation speed .DELTA.NG between the generator rotation speed NG and the target generator rotation speed NG*, and computes a target generator torque TG*. If the differential rotation speed .DELTA.NG is greater, the target generator torque TG* is increased with the positive-negative sign being considered.

Detail Description Paragraph (186):
[0215] Subsequently, the generator torque restriction processing means of the generator rotation speed control processing means performs a generator torque restriction process, in which the system voltage Vsys is read, and the generator torque TG is restricted corresponding to the system voltage Vsys. Therefore, the generator torque restriction processing means computes the maximum generator torque TGmax of the generator torque TG corresponding to the system voltage Vsys with reference to the generator torque restriction map of FIG. 20 recorded in the recording device in the vehicle control device 51 (FIG. 6). Then, the means restricts the generator torque TG based on the maximum generator torque TGmax. In the generator torque restriction map, the maximum generator torque TGmax assumes a predetermined value TG1 if the system voltage Vsys is less than or equal to a predetermined threshold value Vsys1. If the system voltage Vsys is greater than the threshold value Vsys1, the maximum generator torque TGmax is reduced with increases in the system voltage Vsys. Therefore, if the generator 16 is driven at the maximum generator torque TGmax, the target generator torque TG* is reduced as the maximum generator torque TGmax decreases. The generator torque restriction processing means determines the restricted generator torque TG as a target generator torque TG*.

Detail Description Paragraph (187):
[0216] Subsequently, the generator torque control processing means of the generator rotation speed control processing means performs the generator torque control process illustrated in FIG. 17, thereby performing the torque control of the generator 16.

Detail Description Paragraph (188):
[0217] Thus, if the system voltage Vsys becomes greater than the threshold value, the generator torque TG is restricted. Therefore, increases in the load applied to the inverter 28 can be prevented. Furthermore, with regard to the driving of the inverter 28, if the switching of a transistor of the inverter 28 is performed, and therefore, a surge voltage which is a transient voltage transiently occurs so that the system voltage Vsys becomes high, the load applied to the inverter 28 does not increase.

Detail Description Paragraph (192):
[0221] Step S15-7-3: The target generator torque TG* is computed.

Detail Description Paragraph (194):
[0223] Step S15-7-5: The target generator torque TG* is determined.

Detail Description Paragraph (195):
[0224] Step S15-7-6: The generator torque control process is performed. Then, the process returns.

Detail Description Paragraph (199):
[0228] Subsequently, the engine stop control processing means reads the ring gear rotation speed NR, and determines a target generator rotation speed NG* based on the ring gear rotation speed NR and the target engine rotation speed NE* (0 [rpm]), by using the rotation speed relational expression. After the generator rotation speed

control process illustrated in FIG. 19, the engine stop control processing means estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process, as in steps S25 to S27.

Detail Description Paragraph (208):
[0237] Step S16-7: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (209):
[0238] Step S16-8: The target drive motor torque TM* is determined.

Detail Description Paragraph (214):
[0243] First, the generator brake engagement control processing means switches a generator brake request for requesting engagement of the generator brake B (FIG. 6) from an off-status to an on-status, and sets 0 [rpm] as a target generator rotation speed NG*, and performs the generator rotation speed control process illustrated in FIG. 19. After that, as in steps S25 to S27, the generator brake engagement control processing means estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process.

Detail Description Paragraph (215):
[0244] Next, the generator brake engagement control processing means determines whether the absolute value of the generator rotation speed NG is less than a predetermined second rotation speed Nth2 (e.g., 100 [rpm]). If the absolute value of the generator rotation speed NG is less than the second rotation speed Nth2, the means switches the generator brake B from an off-state to an on-state, thereby engaging the brake. Subsequently, the generator brake engagement control processing means estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process, as in steps S25 to S27.

Detail Description Paragraph (220):
[0249] Step S22-3: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (221):
[0250] Step S22-4: The target drive motor torque TM* is determined.

Detail Description Paragraph (225):
[0254] Step S22-8: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (226):
[0255] Step S22-9: The target drive motor torque TM* is determined.

Detail Description Paragraph (231):
[0260] While the generator brake B (FIG. 6) is engaged in the generator brake release control process, a predetermined engine torque TE acts on the rotor 21 of the generator 16. Therefore, if the generator brake B is simply released, the engine torque TE is transferred to the rotor 21, so that the generator torque TG and the engine torque TE greatly change, thereby causing shocks.

Detail Description Paragraph (232):
[0261] Hence, in the engine control device 46, the engine torque TE transferred to the rotor 21 is estimated or computed. The generator brake release control processing means reads a torque corresponding to the estimated or computed engine torque TE, that is, the engine torque-corresponding amount, and sets the engine torque-corresponding amount as a target generator torque TG*. Subsequently, the generator brake release control processing means performs the generator torque control process illustrated in FIG. 17, and then estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process as in steps S25 to S27.

Detail Description Paragraph (233):
[0262] At the elapse of a predetermined time following the start of the generator torque control process, the generator brake release control processing means switches the generator brake B from the on-state to the off-state, thereby releasing the brake. After setting the target generator rotation speed NG* at 0 [rpm], the means performs the generator rotation speed control process illustrated in FIG. 19.

Subsequently, the generator brake release control processing means estimates a drive shaft torque TR/OUT, and determines a target drive motor torque TM*, and performs the drive motor control process as in steps S25 to S27. The aforementioned engine torque-corresponding amount is estimated or computed by learning the torque ratio of the generator torque TG to the engine torque TE.

Detail Description Paragraph (235):
[0264] Step S24-1: The engine torque-corresponding amount is set as a target generator torque TG*.

Detail Description Paragraph (236):
[0265] Step S24-2: The generator torque control process is performed.

Detail Description Paragraph (237):
[0266] Step S24-3: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (238):
[0267] Step S24-4: The target drive motor torque TM* is determined.

Detail Description Paragraph (244):
[0273] Step S24-10: The drive shaft torque TR/OUT is estimated.

Detail Description Paragraph (245):
[0274] Step S24-11: The target drive motor torque TM* is determined.

Detail Description Paragraph (247):
[0276] If any one of the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76 has a detection abnormality due to a broken wire, a short circuit or the like, it becomes impossible to normally detect the battery voltage VB, the generator inverter voltage VG or the drive motor inverter voltage VM, and therefore it becomes impossible to smoothly perform various drive controls such as the torque control of the generator 16, the rotation speed control of the generator 16, the torque control of the drive motor 25, etc.

Detail Description Paragraph (248):
[0277] Below described will be a second embodiment of the invention that is designed so that various drive control can be smoothly performed even if a broken wire or a short circuit occurs in any one of the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76.

Detail Description Paragraph (250):
[0279] First, the system voltage determination processing means 91 (FIG. 1) reads the battery voltage VB, which is a result of detection by the battery voltage sensor 72 as a third voltage detection means, and reads, via the generator control device 47 (FIG. 6), the generator inverter voltage VG, which is a result of detection by the generator inverter sensor 75 as a first voltage detection means, and reads, bia the drive motor control device 49, the drive motor inverter voltage VM, which is a result of detection by the drive motor inverter sensor 76 as a second voltage detection means. Next, a detection abnormality determination processing means (not separately shown) of the system voltage determination processing means 91 performs a detection abnormality determination process, in which abnormality determination regarding the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM is performed based on the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM. That is, the detection abnormality determination processing means determines whether first to third judgment conditions are met, based on whether the battery voltage VB is greater than a threshold value Vth11, and whether the generator inverter voltage VG is greater than the threshold value Vth11, and whether the drive motor inverter voltage VM is less than or equal to a threshold value Vth12. If the first to third judgment conditions are met, the detection abnormality determination processing means determines that the drive motor inverter sensor 76 has a broken wire.

Detail Description Paragraph (251):
[0280] If at least one of the first to third judgment conditions is not met, that is, if the battery voltage VB is less than or equal to the threshold value or the

generator inverter voltage VG is less than or equal to than the threshold value Vth11 or the drive motor inverter voltage VM is greater than the threshold value Vth12, the detection abnormality determination processing means determines whether fourth to sixth judgment conditions are met, based on whether the battery voltage VB is less than or equal to the threshold value Vth12, and whether the generator inverter voltage VG is less than or equal to the threshold value Vth12, and whether the drive motor inverter voltage VM is higher than the threshold value Vth11. If the fourth to sixth judgment conditions are met, the detection abnormality determination processing means determines that the drive motor inverter sensor 76 has a short circuit. If at least one of the fourth to sixth judgment conditions is not met, that is, if the battery voltage VB is greater than the threshold value Vth12 or the generator inverter voltage VG is higher than the threshold value Vth12 or the drive motor inverter voltage VM is less than or equal to the threshold value Vth11, the detection abnormality determination processing means determines that the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76 are normal. Although in this embodiment, the threshold value Vth12 is set less than the threshold value Vth11, the threshold values Vth11 and Vth12 may be equal to each other.

Detail Description Paragraph (252):
[0281] Then, if it is determined that the drive motor inverter sensor 76 has a broken wire, or if it is determined that the drive motor inverter sensor 76 has a short circuit, the system voltage determination processing means 91 sets the battery voltage VB or the generator inverter voltage VG as a system voltage Vsys. If it is determined that the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76 are all normal, the system voltage determination processing means 91 sets the battery voltage VB, the generator inverter voltage VG or the drive motor inverter voltage VM as a system voltage Vsys.

Detail Description Paragraph (253):
[0282] In this embodiment, in order to determine whether the drive motor inverter sensor 76 has a broken wire or has a short circuit, it is determined whether the battery voltage VB is greater than the threshold value Vth11, and whether the generator inverter voltage VG is greater than the threshold value Vth11, and whether the drive motor inverter voltage VM is less than or equal to the threshold value Vth12, and it is also determined whether the battery voltage VB is less than or equal to the threshold value Vth12, and whether the generator inverter voltage VG is less than or equal to the threshold value Vth12, and whether the drive motor inverter voltage VM is greater than the threshold value Vth11. It is also possible to determine whether the battery voltage sensor 72 and the generator inverter sensor 75 have a broken wire or a short circuit in a similar manner.

Detail Description Paragraph (254):
[0283] For example, for the determination as to whether the battery voltage sensor 72 has a broken line or a short circuit, it is determined whether the generator inverter voltage VG is greater than the threshold value Vth11, and the drive motor inverter voltage VM is greater than the threshold value Vth11, and whether the battery voltage VB is less than or equal to Vth12, and it is also determined whether the drive motor inverter voltage VM is less than or equal to the threshold value Vth12, and whether the generator inverter voltage VG is less than or equal to the threshold value Vth12, and the battery voltage VB is higher than the threshold value Vth11. For the determination as to whether the generator inverter sensor 75 has a broken line or a short circuit, it is determined whether the battery voltage VB is greater than the threshold value Vth11, and whether the drive motor inverter voltage VM is greater than the threshold value Vth11, and whether the generator inverter voltage VG is less than or equal to the threshold value Vth12, and it is determined whether the battery voltage VB is less than or equal to the threshold value Vth12, and whether the drive motor inverter voltage VM is less than or equal to the threshold value Vth12, and whether the generator inverter voltage VG is greater than the threshold value Vth11.

Detail Description Paragraph (255):
[0284] Thus, it is possible to determine whether any one of the battery voltage sensor 72, the generator inverter sensor 75 and the drive motor inverter sensor 76 has a detection abnormality due to a broken wire or a short circuit, based on the

battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM, that is, based on a result of comparison of two of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM with a threshold value, and a result of comparison of the other one of them with a threshold. Therefore, it is possible to determine a system voltage Vsys based on voltages of the battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM that do not have a detection abnormality. Hence, it is possible to smoothly perform various drive controls, such as the torque control of the generator 16, the rotation speed control of the generator 16, the torque control of the drive motor 25, etc.

Detail Description Paragraph (257):
[0286] Step S1-11: The battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM are read.

Detail Description Paragraph (258):
[0287] Step S1-12: It is determined whether the battery voltage VB is greater than the threshold value Vth11, and the generator inverter voltage VG is greater than the threshold value Vth11, and the drive motor inverter voltage VM is less than or equal to the threshold value Vth12. If the battery voltage VB is greater than the threshold value Vth11 and the generator inverter voltage VG is greater than the threshold value Vth11 and the drive motor inverter voltage VM is less than or equal to the threshold value Vth12, the process proceeds to step S13, if the battery voltage VB is less than or equal to than the threshold value Vth11, or if the generator inverter voltage VG is less than or equal to than the threshold value Vth11, or if the drive motor inverter voltage VM is greater than the threshold value Vth12, the process proceeds to step S15.

Detail Description Paragraph (259):
[0288] Step S1-15: It is determined whether the battery voltage VB is less than or equal to the threshold value Vth12, and the generator inverter voltage VG is less than or equal to the threshold value Vth12, and the drive motor inverter voltage VM is greater than the Vth11. If the battery voltage VB is less than or equal to the threshold value Vth12 and the battery voltage VB is less than or equal to the threshold value Vth12 and the drive motor inverter voltage VM is greater than the threshold value Vth11, the process proceeds to step S1-16. If the battery voltage VB is greater than the threshold value Vth12, or if the generator inverter voltage VG is greater than the threshold value Vth12, or if the drive motor inverter voltage VM is less than or equal to the threshold value Vth11, the process proceeds to step S1-18.

Detail Description Paragraph (261):
[0290] Step S1-17: The battery voltage VB or the generator inverter voltage VG is set as a system voltage Vsys. After that, the process ends.

Detail Description Paragraph (262):
[0291] Step S1-18: The battery voltage VB, the generator inverter voltage VG and the drive motor inverter voltage VM is set as a system voltage Vsys. After that, the process ends.

Detail Description Paragraph (263):
[0292] Although in this embodiment, the generator torque TG is restricted if the system voltage Vsys is high, it is also possible to restrict the drive motor torque TM in that case.

Detail Description Paragraph (265):
[0294] As described in detail above, in various exemplary embodiments according to the invention, the hybrid type vehicle drive control apparatus includes an electric generator that generates an electric power by driving an engine; an electric generator inverter for driving the electric generator; a drive motor that drives a hybrid type vehicle; a drive motor inverter for driving the drive motor; a battery connected to the electric generator inverter and the drive motor inverter; first voltage detection means for detecting a voltage applied to the electric generator inverter; second voltage detection means for detecting a voltage applied to the drive motor inverter; third voltage detection means for detecting a battery voltage;

and system voltage determination processing means for determining a system voltage based on detection results provided by the first to third voltage detection means.

Detail Description Paragraph (266):
[0295] In these exemplary embodiments, if any one of the voltage information pieces from any one of the first to third voltage detection means has a detection abnormality, it is possible to determine the system voltage based on the detection results provided by the first to third voltage detection means. Therefore, the apparatus is able to smoothly perform various drive controls such as the torque control of the electric generator, the rotation speed control of the generator, the torque control of the drive motor, etc.

CLAIMS:

1. A hybrid type vehicle drive control apparatus comprising: an electric generator that generates an electric power by driving an engine; an electric generator inverter for driving the electric generator; a drive motor that drives a hybrid type vehicle; a drive motor inverter for driving the drive motor; a battery connected to the electric generator inverter and the drive motor inverter; a first voltage detection device that detects a voltage applied to the electric generator inverter; a second voltage detection device that detects a voltage applied to the drive motor inverter; a third voltage detection device that detects a battery voltage; and system voltage determination processing means for determining a system voltage based on detection results provided by the first to third voltage detection devices.

9. A method for controlling a hybrid type vehicle drive apparatus having an electric generator that generates an electric power by driving an engine an electric generator inverter for driving the electric generator, a drive motor that drives a hybrid type vehicle, a drive motor inverter for driving the drive motor, and a battery connected to the electric generator inverter and the drive motor inverter, the hybrid type vehicle drive control method comprising: detecting a voltage applied to the electric generator inverter by a first voltage detection device; detecting a voltage applied to the drive motor inverter by a second voltage detection device; detecting a battery voltage by a third voltage detection device; and determining a system voltage based on detection results provided by the first to third voltage detection devices.

10. A program of a hybrid type vehicle drive control method, wherein a computer functions as: a first voltage detection device that detects a voltage applied to an electric generator inverter; a second voltage detection device that detects a voltage applied to a drive motor inverter; a third voltage detection device that detects a battery voltage; and a system voltage determination processing means for determining a system voltage based on detection results provided by the first to third voltage detection devices.